

Criminal Enterprises: Evidence from Rio de Janeiro*

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Abstract

Many peripheral areas in urban cities are marked by the presence of criminal groups that exert coercion in order to establish local monopolies of legal and illegal goods and services. Some criminal groups expand their enterprises uncontested, while others have their turfs constantly challenged by rival groups and the state. To understand why, we develop a model to analyze the strategic decision of criminal groups to fight their challengers. We test the predictions of the model using a novel dataset ensuing from 420,000 citizen reports on criminal groups' activities in Rio de Janeiro, a unique setting where drug factions and police-linked militia groups control territories. We explore within neighborhood variation in their presence over a 12-year period to test the model predictions. We show that violence levels and economic diversification vary with group type. Neighborhoods solely controlled by police-linked criminal groups are less violent, less exposed to state military intervention and have higher criminal group economic diversification. Our findings indicate a trade-off between violence and criminal group economic outreach.

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1 Introduction

Criminal groups are considered one of the most significant urban and national security challenges of the 21st century (World Bank, 2011). These groups establish subnational criminal governance regimes and control territories to exploit illicit markets (Arias & Barnes, 2017; Lessing, 2020; Mantilla & Feldmann, 2021; Trejo & Ley, 2021a). The vast majority of these groups are associated with illicit drug trade, but several accounts indicate that criminal groups are no longer restrained to drug trafficking. Extortion practices are an important source of illegal profits both in Mexico (Magaloni et al, 2019) and El Salvador (Brown et al, 2022), while loan sharking and debt collection are also source of rents in Medellín (Blattman et al, 2022). The literature has also documented that criminal groups participate in the trade of licit goods such as avocados and oil in Mexico (Estancona and Tiscornia, 2022; Herrera and Martinez-Alvarez, 2021). Yet we still do not know under what conditions criminal groups are able to diversify their business streams. While some criminal groups expand and diversity their revenue streams uncontested, other groups face repression from the state and dispute territories with other rival criminal groups.

In order to extract profits from the illegal trade of both licit and illicit activities, criminal groups must retain monopolistic control of their territories. Control of the territory often requires armed presence and produces violence when turfs are contested by rival groups (Calderon 2020, Trejo and Ley, 2017; Trejo and Ley, 2020, Moncada). Additionally, criminal groups operate in territories with strong state apparatus.¹ States' policies affect the behavior of criminal groups (Castillo and Kronick, 2021) as well as can escalate violence (Dell, 2015; Lessing, 2015; Magaloni et al., 2020). Therefore, *de facto* control of a territory depends if other criminal groups contest their turfs and if the state repress their activities. In this paper, we explore how these dynamics can influence diversification of revenue streams in legal and illegal markets. We argue that disputes between criminal groups (turf wars) and state intervention (cartel-state conflict) are central to explain how criminal groups become multi-product enterprises.

To theorize the mechanisms that drive diversification, we build a model with two scenarios to illustrate the strategic interaction between criminal groups and the state. In the first scenario, there is only one criminal group and the state. The criminal group extracts rents from its local territory and decides whether to fight or bribe the police. The state balances the

¹We focus on settings where states have highly militarized police forces and capacity to enforce rules and punish violators.

political return to its use of military force versus the bribe it collects to not repress criminal activities. There is a peace dividend that arises when there is no military confrontation because criminal groups are able to put resources into exploiting additional markets. Therefore, this game has two equilibria. One equilibrium has a high level of conflict and low economic diversification. There is also a peaceful equilibrium where the criminal group is able to bribe the government, avoid repression, and exploit the provision of other goods and services. Politically connected groups that are able to avoid losses from state repression end up in the second equilibrium. In addition, the model shows that the bribe needed to avoid state repression increases with the political return to the use of military force. In the second scenario, there are two criminal groups and the state. The incumbent criminal group chooses to invest in military capacity to protect its territory from the two enemies and conquer new territories to increase its profits. Therefore, we expect higher levels of conflict, which affect criminal groups' capacity to diversify economically. The peaceful equilibrium in that case requires more stringent conditions. The state and the rival group must not fight and the incumbent group must acquire more benefits from exploring new markets in its own territory than to try to get rents from other groups' territory.

We test this model by analyzing Rio de Janeiro's armed criminal groups and its interaction with the police repression apparatus. Rio de Janeiro offers a great setup to study criminal dynamics and state response since three drug factions and police-linked militia groups have controlled vast parts of the territory in the past 30 years. We build a unique dataset to map and describe the geospatial distribution of criminal groups in the metropolitan region of Rio de Janeiro, where 13.1 million of people reside. Additionally, we identify the wide-range portfolio of activities exploited by them and document how they have changed over time. The data stem from *Disque Denuncia* (Dial Report in English), a well-established crime tip line with more than 1.4 million reports, among which 420,000 are explicit mentions to criminal groups in Rio de Janeiro. We use Natural Language Processing techniques to classify transcribed text reports into group activities and use a strict rule to measure whether a neighborhood has the presence of a criminal group that militarily controls the territory and illegally exploits different economic activities. We combine our data with administrative data based on police intelligent information and other sources to cross-check and validate the accuracy of our estimates. With validated measures of group presence and diversification, we focus our analysis to estimate how group dynamics affect violence and economic diversification.

We have three sets of results. First, we present the first yearly measure of

presence of criminal groups at the neighborhood level.² Despite the state’s efforts to curb these groups in the past years, the number of neighborhoods with group presence has not varied much in the city of Rio de Janeiro. We observe an expansion of criminal presence in the outskirts of the city. We find that, on average, 41% of neighborhoods in the Rio de Janeiro metropolitan area have at least some of its area controlled by a criminal group from 2008 to 2019. These neighborhoods contain 72% of the population that lives in the metropolitan area.³ Second, we identify that criminal groups participate in several economic activities, both licit and illicit activities, from drug trade and extortion to provision of cable TV and internet and sell of cooking gas cylinders. Third, we explore variation over time in violence levels, revenue streams, and criminal consolidation, i.e. when groups operate in uncontested areas. We show that criminal consolidation is associated with lower levels of violence and higher business diversification. The results vary by group type, as predicted by the model. When militia groups govern solely in a neighborhood, homicide levels, shooting and police killings are lower, while economic diversification increases. However, territories controlled by a single drug faction are still more likely to experience state repression, affecting ability to explore new markets.

We contribute to a burgeoning literature that uses several methods and data sources to measure the presence of criminal groups.⁴ Although our paper is not the first to explore the richness of Disque Denuncia⁵, our study is the first one to apply cutting-edge techniques to the detailed Disque Denuncia dataset to systematically measure specific armed groups presence in Rio de Janeiro for 12 years. We contribute to seminal works that describe the presence and operation of criminal groups in Brazil and elsewhere (Cano & Ioot, 2008; Misse, 2011; Zaluar & Barcellos, 2013).⁶ The present study advances this agenda by measuring different criminal groups and how their presence and economic diversification changes in the last decade.

²The reports from *Disque-Denuncia* provide addresses as references to the reported events, which does not allow us to calculate the extension of the territory within neighborhoods controlled by groups.

³According to the 2010 Census.

⁴See Sobrino (2019) for the use of Google news, Dipoppa (2020) collects articles discussing typical mafia-related crimes from a national newspaper in Italy, Lonsky (2019) uses crime reports on the Russia mafia, and Bruhn (2021) exploit police intelligence data on Chicago’s gangs.

⁵Cano and Duarte (2012) uses a sample of Disque Denuncia reports to measure the presence of militia groups from 2006 to 2011.

⁶Recently, a collaborative project of five organizations led by the group GENI-UFF created a map of armed groups in Rio de Janeiro. The map can be accessed through the website: <https://nev.prp.usp.br/mapa-dos-grupos-armados-do-rio-de-janeiro/>.

Additionally, our paper expands our understanding about criminal groups' relationship with the state and other criminal groups and how it impacts their ability to diversify economically. Armed groups often have relations with at least some state officials and varying combinations of these relationships determine greater confrontation or even cooperation with the state (Arias, 2006). Lessing (2020) conceptualizes the symbiotic relationship between criminal groups and the state, which is also known as the hybrid state (Jaffe, 2013), the gray zone of criminality (Trejo & Ley, 2021b), state sponsored protection rackets (Snyder & Duran-Martinez, 2009), and the complicit state (Yashar, 2018) and it is based on the capacity of state agents to explore *mercadorias politicas* or political goods (Misse, 2006, 2010). In this paper, we detail the incentives criminal groups face to engage in negotiations and bribe state agents, thus not only avoiding repression but also allowing them to exploit additional markets. Our paper is closely related to Castillo and Kronick (2020) in examining the effects of state repression on criminal groups' interactions. However, to the best of our knowledge, previous work does not explicitly examine the impacts of state repression and turf wars on the economic diversification of criminal groups.

Our framework also allows us to highlight a key distinction between territorial criminal groups, which is their ability to collude with the state. This distinction makes highly connected groups less subject to police military repression, which enables an equilibrium with low levels of violence and higher economic diversification. Therefore, we explore the role of criminal groups as firms to understand the equilibrium in which they are able to expand their activities and connect our paper with the literature that analyzes the activities of criminal firms (Blattman et al., 2018; Brown et al., 2021; Fiorentini & Peltzman, 1997; Gambetta, 1996; Gambetta & Reuter, 1997; Levitt & Venkatesh, 2000). This suggests that governments should fight organized crime not only militarily but also economically. Poor results associated with government crackdowns suggest that the “war” against criminal groups requires new strategies and a better understanding on how these groups rule their territories, their sources of revenue, networks and motives to engage in turf wars.

2 Overview of Criminal Enterprises in Rio de Janeiro

Broadly, there are two types of criminal groups in Rio that exert armed control of territories in Rio de Janeiro: drug factions and militias — paramilitary

groups usually formed by current and former police officers. Below we discuss these groups, how they emerged and rose, and their relationship with the state.

2.1 Drug Factions

Violence in Rio de Janeiro increased rapidly in the early 1980s. This period is marked by the entrance of *Comando Vermelho* (CV), the first prison-based gang in Brazil, in the market of retail drug trade.⁷ Drug dealers utilized the marijuana trade network already established in Rio de Janeiro’s favelas to sell cocaine. Control over the favelas’ territory became crucial to protecting the illicit and lucrative trade. The favelas’ geography, with tiny streets and crowded corners, as well as a lack of enforcement of formal rules within its boundaries, make them an important market for drugs as well as a strategic place to hide from police (**Silva2008**). The higher profitability of cocaine trade changed drug trade dynamics and soon led to an increasing disputes among gang members. As a result, some members left *Comando Vermelho* and created *Terceiro Comando* (TC) in the late 1980s (**Misse1999**). In the 1990s, two additional gangs, *Amigos dos Amigos* (ADA) and *Terceiro Comando Puro* (TCP), were created by dissidents of the two former gangs. This fractionalization led to more battles over the control of favelas, and to an increasing militarization of the drug gangs (**Misse1997**). The arsenal used in the conflicts has often included heavy weaponry, such as grenades and modern military machine guns, leading to high death tolls even among those not directly involved in the drug trade.⁹

Historically, these gangs have disputed territories around the city to monopolize drug sales.¹⁰ In addition, they impose restrictions on residents’ rights to entry and exit *favelas* partly as a response to these conflicts. Residents of a *favela* controlled by a drug faction cannot enter a *favela* dominated by a rival gang for any business or personal reason (Zaluar, 2012). The conflict between these groups generates much of the crossfire and gun violence that mark the city of Rio de Janeiro (Monteiro & Rocha, 2017).

⁷Scholars link the emergence of *Comando Vermelho* (CV) to the dictatorship’s attempt to repress armed political opposition (Amorim, 1993; Lima, 2001; Misse, 2006).⁸ According to Penglase (2008), the CV emerged in the 1970s in a prison where members of armed political groups and regular prisoners were housed in the same unit. The group of prisoners gathered together and organized a movement against state repression and for better living conditions within the prison system (Amorim, 1993).

⁹According to the 2009 ISP Annual Report, about 30% of all illegal weapons collected through police operations in 2009 in the State of Rio de Janeiro were classified as weapons of “high destructive power”, such as large-caliber machine guns.

¹⁰For more on turf wars, see: Dowdney (2003) and Gay (2015).

Rio de Janeiro’s drug syndicates operate as a loose affiliation of autonomous drug firms whose bosses engage in mutual aid and occasional coordinated efforts (Lessing, 2017). Each favela typically has a local boss who runs the operations independently and who decides how to defend the territory and whether to attack his rivals.

Rio de Janeiro’s are also marked by inter state-armed group conflict. The police is hardly seen patrolling favela areas and teenage traffickers protect the turf with automatic rifles and openly sell cocaine and marijuana. Once in a while, the police promote militarized incursions into the favelas to capture or kill traffickers and seizure drugs and weapons. Some of these crackdowns are publicized by the media, while the police uses apprehension of automatic rifles as one of its key indicator of success.¹¹ Traffickers usually fight back which creates shootouts that go on for hours and put civilians under the risk of being shot by stray bullets. Hundreds of clashes per year generate civil war levels of casualties. In 2021, Rio de Janeiro registered over 1300 police killings, which indicate that the police alone is responsible for a murder rate of 8 per 100,000 habitants. However, clashes do not take place everywhere and anytime. In many favelas, armed groups often pay weekly or monthly bribes to local police battalions in exchange for non-enforcement. These arrangements are so common that there is a nickname to refer to it: *arrego*.

2.2 Police-Linked Militias

While drug factions were fractionalizing and fighting against each other and the state, another type of group emerged in Rio: *militias*. These groups are often formed by members of the military police and other public security agents that use extra-legal methods to combat organized crime and drug trafficking.

The term *militias* has also been broadly used to name any corrupt or violent police officer, leading to a very broad and imprecise definition of this type of criminal group (Santos, 2007).¹² In this study we focus on *militias* that seek territorial control to extract rents from extortion or other economic

¹¹Newspapers and TV news report on these operation often as successful policies. For example, <https://g1.globo.com/rj/rio-de-janeiro/noticia/2022/01/26/policia-apreende-cerca-de-200-quilos-de-drogas-no-jacarezinho.ghtml>

¹²The first organizations of police officers specialized in killings were called *grupos de extermínio* (death squads) and go back to the period of military dictatorship in Brazil during the 1960s to the 1980s. Some scholars do link these groups to what we have come to know as *militias* (Souza, 2012). However, some *grupos de extermínio* are still in operation to this day. They are often hired by businessmen or politicians to execute competitors, political opponents, or other targets (Cano & Duarte, 2012). See Paes Manso (2019) for a description of how *militias* work in Rio de Janeiro.

activities.¹³ As such, they use coercion to create protection rackets (Tilly, 1985). In *favelas* and poor neighborhoods, where people do not have access to the legal system, security agents become local authorities and enforce extralegal rules (Zaluar, 2012). Citizens have to pay taxes to militia groups for “security.” However, people were often paying taxes to protect themselves from the same group that was charging them. In that sense, militias resemble the Sicilian mafia that rose in a vacuum of power or of the inability of the state to ensure public order in a society that had turned away from state power to private means of protecting power and ensuring order (Catanzaro, 1992).

Militias are police-linked groups and have a symbiotic relationship with the state that has allowed them to control territories within the boundaries of the city.¹⁴ This symbiotic relationship between criminals and state agents is called the “gray zone of criminality” by Trejo and Ley (2021b). Instead of recognizing the state and crime as two separate entities, the gray zone of criminality is where members of public security institutions co-exist alongside criminal groups. In other words, police forces and state agents cooperate with organized crime and coordinate actions to serve them.

In the next sections, we explore how differences between drug factions and militias affect levels of conflict and state repression as well as their ability to diversify economically.

3 Data on Criminal Enterprises

The main challenge in understanding armed group characteristics is to gather information on their activities and presence in the territory due to their illegal nature and violent practices. Many existing studies for different contexts

¹³Our definition of militias is similar to the one used by Cano and Duarte (2012). They characterize militias using a five-point definition: (1) territorial control; (2) coercion over residents in controlled territories; (3) individually rationally-motivated profit; (4) discourse based on protection and establishment or order; (5) participation of state agents within public security institutions.

¹⁴Using qualitative research techniques such as focus groups and interviews with locals, Mesquita (2008) reconstructs the violent formation process of the Rio das Pedras militia in the early 1990s, and shows how this had an impact on people’s daily lives. The events are also described in a resident’s report published by O Globo newspaper (<https://oglobo.globo.com/epoca/rio/o-nascimento-da-milicia-em-rio-das-pedras-pela-visao-de-um-morador-23831103>), in which the participation of public security agents is emphasized. More recently, in an ethnography carried out in the Batan *favela*, also in the West Zone of Rio de Janeiro, Mendonça (2014) describes how, in September 2007, a group of policemen, military men and firefighters “expelled” a drug trafficking faction from and established territorial control over the place.

use crime reports, police intelligence data (Bruhn, 2021), newspaper data (Daniele & Dipoppa, 2017; Trejo & Ley, 2017), and Google news (Sobrino, 2019). In the case of Brazil, previous works mostly focus on case studies of specific groups or lack systematic information on group activities.

3.1 *Disque-Denuncia* Data

Our paper circumvents these problems using information from *Disque-Denúncia* (DD), a hotline that receives anonymous reports from citizens regarding an array of criminal behavior in the state of Rio de Janeiro. Running since 1995, the Non-Governmental Organization (NGO) has compiled a dataset of more than 2 million reports registered between 2002 and 2019. The calls received by the hotline are directly forwarded to civil and military police, which decide whether and how to respond to each report.¹⁵

We were granted access to all 1.4 million reports for Rio de Janeiro’s metropolitan area from 2008 to 2019.¹⁶ This region embraces the city of Rio de Janeiro and 21 neighboring cities, where a total of 13.1 million people live. The DD dataset records the transcription of the reported event, its time, date and address. Even though there is a degree of uncertainty on the precision of reports individually, we argue that the combination of numerous reports represents a unique source of data in understanding criminal dynamics in the state.

Our goal is to use this set of reports to locate groups across time and space and understand their main practices of territorial control and choices of business streams. Therefore, we first filtered reports that explicitly mention armed groups (gang names or militia) or popular names of their members (e.g. drug dealers and militia members), keeping around 420,000 reports. In order to understand how these groups behave in the territory, we then automatically interpret the content of each report, propose a rigorous definition of group presence and validate our approach with data from other sources.

There are a few challenges to use Disque Denuncia data to map the presence of criminal groups. First, the reports are anonymous claims from citizens that have not been confirmed by any investigation. We argue that although a single report might not provide enough evidence to indicate the presence

¹⁵Disque-Denúncia is widely known in the state of Rio de Janeiro, being publicized at bus outdoors as well as constantly mentioned on the main local TV news.

¹⁶When studying only militia groups, Cano and Duarte (2012) analyze in total 41,542 reports. The mentions to militias are sporadic prior to 2008. The years of 2006 and 2007 count for only 12% of all the reports analyzed by the authors. Therefore, we opted to begin our analysis in 2008 since this was the year which the mentions to militias were more consolidated as described in the previous section.

of a criminal group, several similar reports are a good indication of criminal group presence. In section 3.4, we explain how we aggregate reports. Second, we aim to identify different criminal groups that exert control over a territory. For instance, we are not interested in reports that refer only to the drug trade, that give the location of a criminal boss who is a fugitive, or that mention locations where militia men use to hang out. Therefore, we propose a rigorous definition of group presence based on territorial control *and* the exploitation of economic activities and automatically interpret the content of each report to filter reports that indicate the presence of a Territorial Criminal Enterprise. The last challenge is that Disque Denuncia data originate from people requesting help. As a consequence, if criminal groups go quiet and do not harm people despite still controlling the territory, people might be less likely to denounce them. To deal with this issue, we use a more strict definition to identify the presence of a group for the first time. Then, we lower the bar and request fewer reports to indicate that the group is still operating in the area. We validate this approach combining our data with qualitative research that maps criminal groups in 950 *favelas* and official records for years which data are available.

3.2 Other Sources of Data

We cross-check our measure of group presence based on Disque-Denuncia data with three sources of information. We obtained access to two pieces of information from government authorities that provide information for specific years. The State Attorney’s Office of Rio de Janeiro (MPRJ in Portuguese) gathers information on group presence from local police officers that support the work of prosecutors responsible for investigating members of these organizations. The information is organized at the locality level, which can be either a *favela*, a housing project or other poor territory. We were granted access to data at the neighborhood level for 2019. In addition, we gathered data from the Institute of Public Security of Rio de Janeiro (ISP), a state government body responsible for disclose crime records in Rio de Janeiro. ISP compiled a unique map depicting the areas of the state that were subject to illegal territorial control based on police sources in 2016.

These data is complemented by records of field work from Alba Zaluar, a prominent anthropologist from Rio de Janeiro (Zaluar, 2012; Zaluar & Barcellos, 2013). Zaluar carried out field work in more than 950 *favelas* of the city of Rio in 2009, 2010 and 2013. As we previously mentioned, criminal groups are not restricted to *favelas*, which means these data do not cover the universe of groups in these years. Still, *favelas* are arguably the most common type of territory that is run by militias and drug gangs of Rio,

so these data depict the most relevant picture of criminal group presence in the city. These data help us evaluate the quality of our measure of group presence in the territory and allow us to test the consequences of criminal consolidation on group economic decisions. In addition, when analyzing the determinants of diversification, we use Zaluar’s estimates of criminal group presence to regress on our measures of economic activities.

Finally, we gather police records on homicide and police killings provided by the Institute of Public Security (ISP), the state government institution responsible for disclosing crime and violence data. Police killings are people that were killed in confrontation with the police. We measure shootings based on reports to *Fogo Cruzado*, an NGO created in 2016 to collect citizen reports on gun violence in Rio de Janeiro through an app and social media. These data allow us to understand how patterns of violence and state repression correlate with group presence and consolidation in the territory.

3.3 Content Classification

Our goals with the DD data are two-fold. First, we want to create a measure of criminal group presence in the territory. We take two dimensions into consideration: military territorial control and exploitation of economic activities. After identifying groups in the territory, we move to our second goal, which is to build a profile of economic activities of criminal groups. We thus employ a rule-based classification method to automatically classify citizen reports that describe these activities. In order to make the processes more clear and precise when classifying reports, we propose definitions for the practices that characterize each dimension.

Our definition of *Territorial Control* captures the overt actions to protect the territory, i.e. practices of armed circulation (when group members ostensibly bear firearms to maintain control of the territory), roadblocks and surveillance (means of restraining access to the territory). This is shown in Table 1. On Table 2, we show how we measure *Exploitation of Economic Activities*, which may involve extortion (direct payments for protection rackets), illicit goods and services (such as drug trade and gambling) and also licit goods and services (TV and internet, cooking gas and electricity).¹⁷

¹⁷In total, we include ten types of markets exploited by these groups: Extortion, TV Internet, Drug trade, Transportation, Gas, Loan Sharking, Water, Properties and Land, Electricity, Gambling. These categories were based on our reading of Disque-Denuncia reports. We describe specific cases of two activities, transportation and water distribution, in the appendix D.

Table 1: Definition of practices of Territorial Control

Practice	Definition
Armed circulation	Illegally and ostensibly bearing firearms in order to maintain the illegal control of the territory
Roadblocks	Attempts to impede or impose difficulties of access to rivals in the territory – other armed groups or state forces
Surveillance	Surveillance mechanisms aiming at informing the proximity of a rival or other type of threats to the controlled territory

Table 2: Definition of practices of Exploitation of Economic Activities

Practice	Definition
Extortion	“Fee-for-services” in which the groups demand direct payments for protection rackets
Illegal goods and services	Selling illegal products or services such as drug trade, gambling and loan sharking
Legal goods and services	Illegal provision of services to households (TV and internet, cooking gas, water and electricity), transportation, exploitation of lands and properties

In order to classify the reports into these dimensions, we manually studied random samples of the data and defined rules to automatically interpret hundreds of thousands of reports using regular expressions. Since *Disque-Denuncia*’s transcriptions are standardized, this method has an overall good performance, is less costly to implement and more straightforward to interpret compared to other NLP techniques.¹⁸

To evaluate our classification method, we manually classified a random sample of 3,000 observations into the practices of territorial control and economic activities to test the performance of our algorithm. Table 3 details the overall performance of our methods. It shows the accuracy, precision, recall, and F1-Score of each indicator of territorial control and economic activities (Appendix B describes each of these measures). In sum, the results indicate that our algorithm performs well, indicating that we rarely identify a dimension incorrectly.

¹⁸See Appendix A for examples of reports and classification.

Table 3: Measures of algorithm performance

Dimension	Practice	Measures of algorithm performance				Prevalence
		Accuracy	Precision	Recall	F1-Score	
Territorial Control	Armed Circulation	0.939	0.942	0.941	0.941	52%
	Roadblocks	0.961	0.893	0.665	0.762	10%
	Surveillance	0.986	0.900	0.791	0.842	5%
Economic Activities	Extortion	0.973	0.737	0.737	0.737	5%
	TV and Internet	0.998	0.947	0.947	0.947	2%
	Drug trade	0.897	0.974	0.813	0.886	51%
	Transportation	0.994	0.750	0.600	0.667	1%
	Gas*	-	0.920	-	-	<1%
	Loan Sharking*	-	0.860	-	-	<1%
	Water*	-	0.780	-	-	<1%
	Properties and Land*	-	0.780	-	-	<1%
	Electricity*	-	0.760	-	-	<1%
	Gambling*	-	0.640	-	-	<1%

Notes: This table reports measures of algorithm performance for each of the dimensions used to map group presence. Column 3 depicts results for Accuracy (total share of true positives and true negatives in the samples). Column 4 depicts results for Precision (share of positives that are true). Column 5 depicts results for Recall (share of relevant cases that are true positives). Column 6 depicts results for F1-Score (harmonic mean between Precision and Recall). Column 7 depicts the prevalence of each practice in the sample. Appendix B details the exact definition of each measure. *For practices that are rare in the sample (less than 1 %), we randomly re-sampled 100 positive cases to evaluate our rate of predictive power (Precision).

3.4 Criminal Group Presence

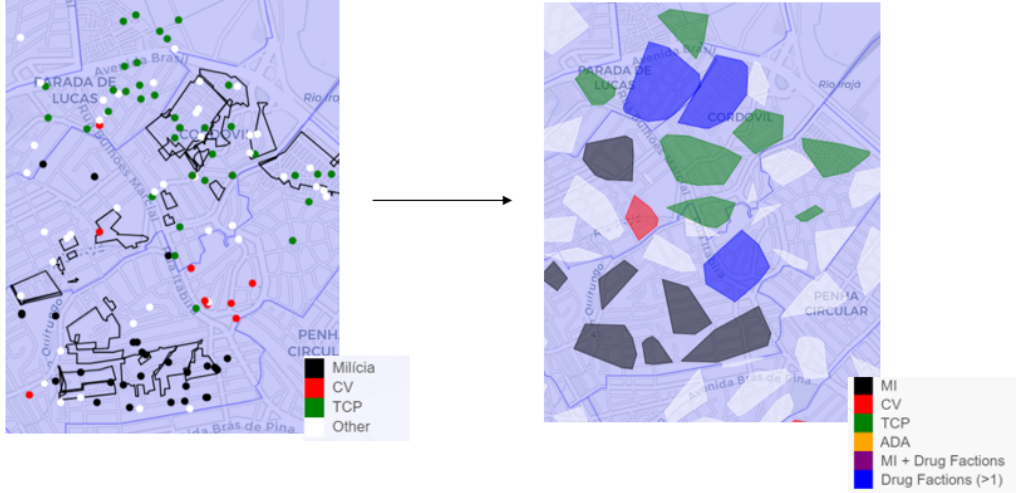
The results from the previous section make us confident that we are able to interpret the content of the reports to Disque Denuncia reasonably well. We then move to the task of using information on the content of each report to build a panel of criminal groups in Rio de Janeiro between 2008 and 2019.

When studying the territorial dynamics of Rio de Janeiro’s criminal groups, most studies focus on *favelas* as the main unit of analysis. However, drug factions and especially militias also control territories outside the boundaries of the slums and inside formal areas of poor neighborhoods. Therefore, we avoid using regular *favela* limits when mapping these groups and take advantage of information on the addresses of the calls to Disque Denuncia to geo-reference their exact location. With the coordinates of each report, we group them in order to identify those that refer to the same territory. We apply a hierarchical clustering algorithm, which aggregates points that are close by 300 meters.¹⁹ Figure 1 exemplifies how groups of reports are clustered

¹⁹Intuitively, the method consists of the repeated process of collecting observations that are closest together to form clusters until the distance of a cluster to a point is greater than

depending on their spatial distribution.

Figure 1: Example of clustering

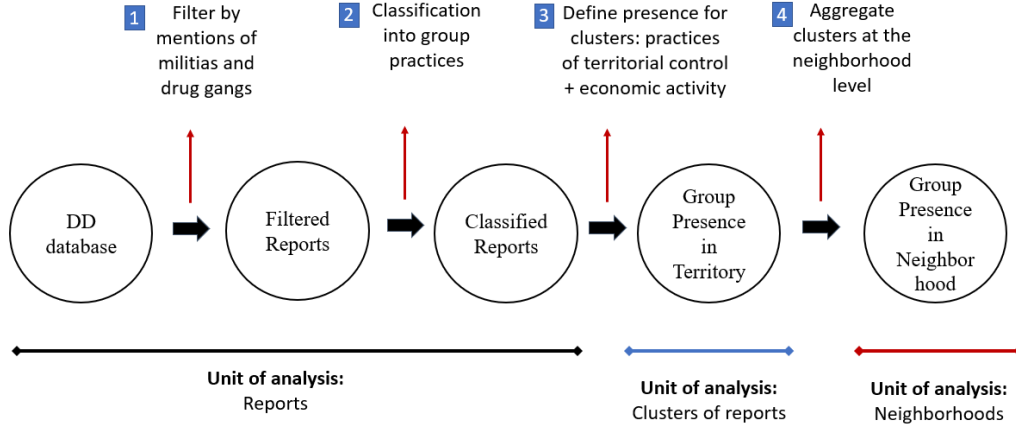


Notes: This figure illustrates how reports from Disque Denuncia are clustered according to their spatial distribution. In black, reports refer to militia groups. In red, reports are about drug gang Comando Vermelho. Green and Yellow refer to TCP and ADA respectively. In purple, we have territories with presence of at least one militia group and one drug faction. In blue, territories with more than one drug faction.

After building clusters of territories based on the exact location of reports, we identify which group is present in each cluster for a particular year if the reports in the cluster mentioned a criminal group name plus the two crucial characteristics of territorial criminal enterprises: use of force to control territories and exploitation of economic activity. Finally, we aggregate these clusters at the neighborhood level to carry out our empirical analysis since our measures of violence are available at this level. Figure 2 summarizes how we use the data from the original database to develop our measure of group presence in the neighborhood.

an arbitrary value. We use $d = 300\text{m}$ and the average linkage, which means we compute the average distance of points in a cluster rather than the closest (single linkage) or the farthest (complete linkage). One advantage of this clustering strategy is that we do not need to impose the number of clusters in advance.

Figure 2: Summary of the process to map group presence



3.5 Validation

To evaluate the performance of our algorithm, we use three sources of information of criminal group presence that are available for specific years of our period of analysis: (i) intelligence unit data from the State Attorney’s Office of Rio de Janeiro for 2019, (ii) a map created by the Institute of Public Security based on police intelligence information for 2016, and (iii) field work records from Alba Zaluar that has identified criminal group presence at the *favela* level for 2009, 2010, and 2013. We aggregate data from these different periods at the neighborhood level for the city of Rio de Janeiro to make comparisons between different sources feasible. For the five years for which we have benchmark information, the correlation between these data and our measurement regarding the number of groups in each neighborhood is around 0.57 on average and around 0.61 if compared with government data. This is similar to previous efforts to map criminal groups.²⁰ In addition, compared with State Attorney’s office data, our algorithm has a recall score (low level of false negative) of 84% and a precision rate (low level of false positives) of 0.65. This validity check makes us more confident in extending our analysis to other years.

²⁰Sobrino (2019)’s efforts in identifying criminal groups in Mexico correlates between 0.34 and 0.69 with official data depending on the year of reference. Dipoppa (2020)’s accuracy to locate Mafia presence in Italy is 78%.

Table 4: Performance compared to other sources of data

	Mean	State Attorney's Office (2019)	ISP (2016)	Zaluar (2013)	Zaluar (2010)	Zaluar (2009)
Correlation (# of groups)	0.567	0.625	0.607	0.539	0.524	0.541
F-Score	0.697	0.729	0.707	0.653	0.682	0.711
Recall (1 - %FN)	0.688	0.837	0.622	0.614	0.676	0.614
Precision (1 - %FP)	0.717	0.646	0.819	0.698	0.689	0.731

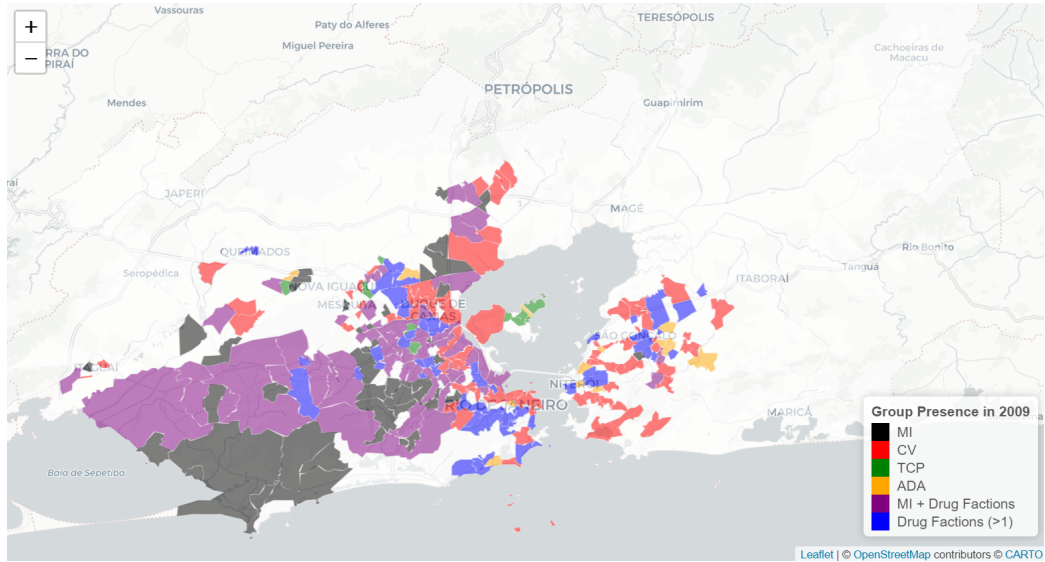
Notes: This table provides scores to evaluate the performance of our measure of presence calculated using the Disque-Denuncia dataset. It compares our measure to existing datasets that captured group presence at specific years. Column 1 indicates the performance measure. Columns 2 takes the mean of columns 3-7. Columns 3-7 indicates the performance values for each dataset. F-score represents the harmonic average of recall and precision scores. Recall evaluates the ability of correctly classifying reports as positive, conditional on the totality of true positive cases in the sample. This cross-check is made only for the city of Rio de Janeiro.

4 Descriptive Analysis

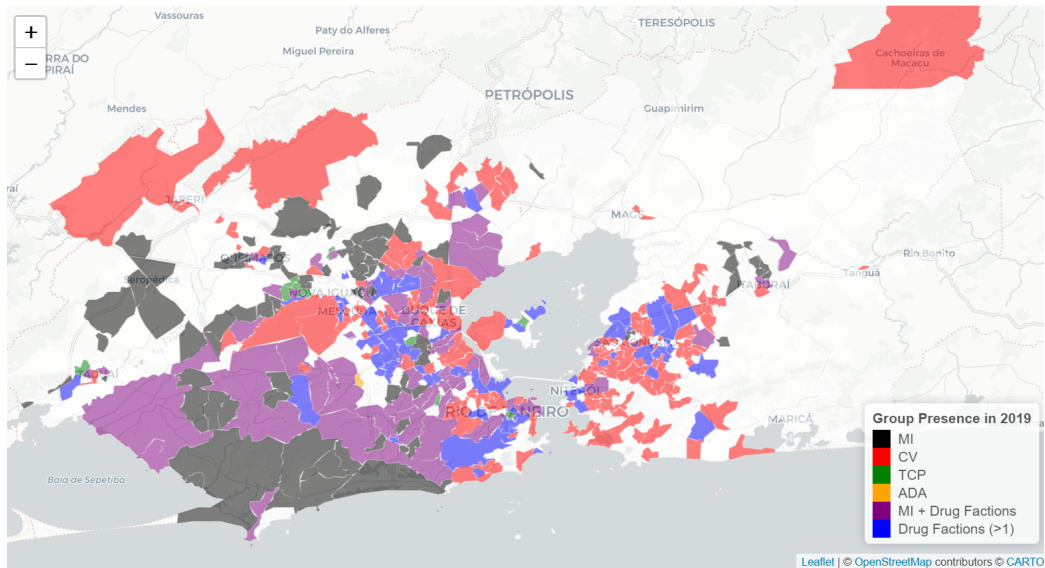
In this section, we document descriptive evidence on criminal groups presence in Rio de Janeiro using our novel panel data. First, we describe how these groups expanded in Rio's metropolitan area between 2008 and 2019. Additionally, we analyze the portfolio of goods and services that these groups exploit in the territories controlled by them. In the next section, we present a theory to explain under what conditions these groups expand and diversify their economic activities.

Figure 5 shows the entire metropolitan region of Rio de Janeiro with neighborhoods colored according to the presence of criminal groups in 2009 and 2019. Each color indicates a specific group or a combination of groups within the neighborhood. We can see that there was an expansion of areas occupied by criminal groups in Rio de Janeiro in ten years.

Figure 3: Criminal presence at the neighborhood level in Rio's metropolitan area



(a) 2009

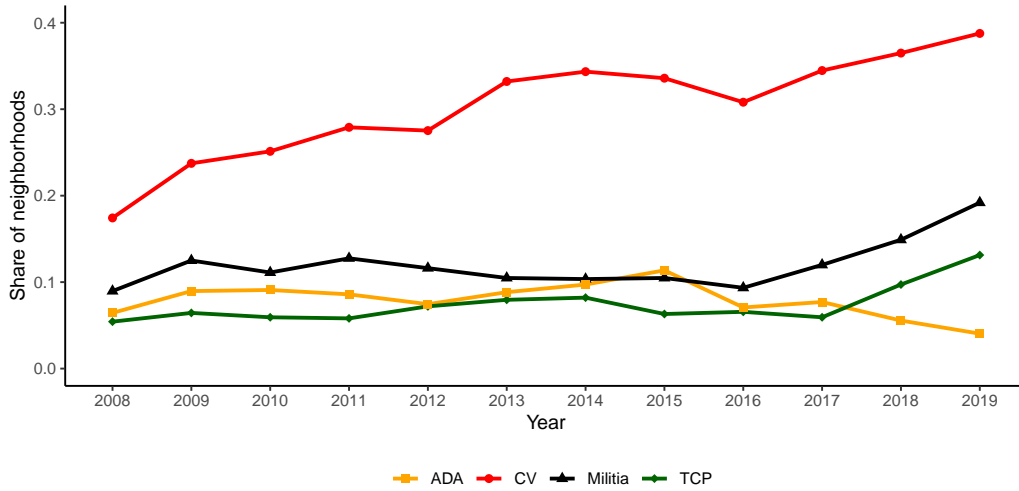


(b) 2019

Notes: This figure shows a map of the Metropolitan Region of Rio de Janeiro to illustrate the spatial variation of presence of territorial criminal groups using data from *Disque Denúncia*. Figure (a) shows the presence of groups at the neighborhood level in 2009. Figure (b) shows the presence of groups at the neighborhood level in 2019. In black, we have the presence of militia groups. In red, we have territories controlled by drug gang Comando Vermelho. Green refers to drug gang TCP and yellow drug gang ADA. In purple, we have territories with presence of at least one militia group and one drug faction. In blue, territories with more than one drug faction.

Next, we look at the share of neighborhoods with presence of each group. Figure 4 shows that the Comando Vermelho (CV) is the most active group in the region, being present in 39 percent of neighborhoods in 2019. Comando Vermelho has increased its presence since 2008, while militia groups and Terceiro Comando Puro (TCP) presented a marked increase in 2018 and 2019. Our data also indicate a decreased presence of the gang Amigo dos Amigos (ADA) since 2018, which matches accounts that this drug gang lost power during that year.²¹ Even though *favelas* and housing projects in the city of Rio are still subject to active changes of power, most of the recent upward trend in group presence is explained by the expansion of criminal groups to neighborhoods in the outskirts of Rio. The maps from figures 3a and 3b present the spatial evidence of this expansion between 2009 and 2019.

Figure 4: Percentage of neighborhoods with presence of each criminal group



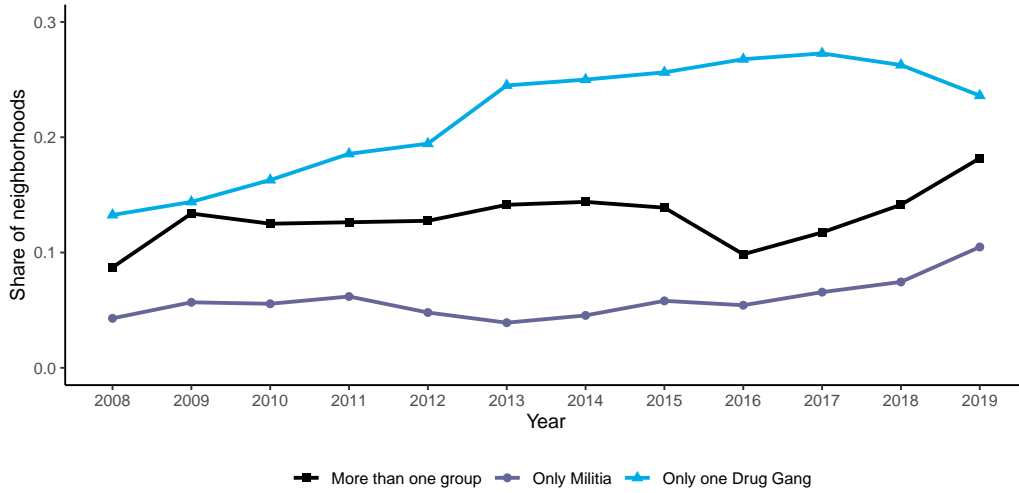
Notes: This figure illustrates the share of neighborhoods in the city of Rio de Janeiro with an indicator of presence of each criminal groups. This is identified by our algorithm using the Disque Denuncia data. The black line indicates the presence of militia. The red line indicates presence of the drug gang Comando Vermelho. Green refers to drug gang TCV and yellow refers to drug gang ADA.

We then present data on whether groups operate alone or govern territories close to other groups' turf. Figure 5 depicts the evolution in the percentage of neighborhoods that are ruled by criminal groups in three mutually exclusive categories: i) only one militia group; ii) one drug gang; and

²¹See <https://projects.theintercept.com/death-of-a-rio-cartel/>

iii) more than one group in the neighborhood (militia or drug gang). In comparison to earlier years, it has become more common for groups to be the only group in a neighborhood. This is one indication of higher levels of criminal consolidation. In the next sections, we explore the broader implications of this surge for criminal groups' economic decisions and violence levels.

Figure 5: Percentage of neighborhoods with different types of criminal groups



Notes: This figure illustrates the share of neighborhoods in the city of Rio de Janeiro with the presence of criminal groups by type. The black line indicates that there is more than one criminal group. The dark blue line indicates presence of only militia groups. The light blue line indicates presence of only drug gangs.

The central contribution of this article is to analyze the economic side of criminal groups. We then proceed our descriptive analysis to report the different economic activities exploited by groups. Many definitions of organized crime are restricted to illegal business. Reuters (2009) define organized criminal groups as private firms that operate illicit markets. These groups often grow by exploiting illegal markets and many studies overlook the economic diversification of criminal groups. Yet, economic diversification is seen in several contexts. The engagement of organized criminal groups into the trade and service of licit activities has been documented in studies about the mafia (Anderson, 1997) and for combos that operate in Medellin, Colombia (Blattman et al., 2018). Criminal groups do not restrict their activities to illegal markets and they do not only seek to govern and control the whole economic structure of the underworld Schelling (1971) but to maximize profits.

Table 5 describes the share of different types of economic activities exploited by the criminal groups in Rio de Janeiro. Panel A presents illicit activities, i.e. goods and services that are considered criminal businesses such as drug trafficking, extortion, loan sharking, and gambling. Panel B presents licit activities or services that are also provided by private companies and firms not related to crime, such as cable TV and gas.²² Historically, militias have focused on extortion while drug gangs, which often have members that grow up in the communities they govern, are known to avoid extorting community members. Their main business is centered around drug trafficking. However, Table 5 shows that both militias and drug gangs exploit a wide range of economic activities.

Panel A of Table 5 shows that while drug trafficking is exploited by virtually all drug gangs, the militias' main source of revenue is extortion fees.²³ Importantly, we show that militias often sell drugs (22% in 2019) and drug gangs extract rents from extortion (30% in 2019). This evidence highlights the necessity of studying these groups through the unique lenses of Territorial Criminal Enterprises, since criminal groups are not restricted to unique economic activities. Moreover, the results from the table point to a relative change for militias from illegal gambling to loan sharking between 2009 and 2019.

To expand our analysis to licit goods and services, Panel B in Table 5 presents the share of groups exploring activities such as the provision of cable TV and internet, informal transportation, and the distribution of water and cooking gas, among others. To reinforce our previous results, the main result from this panel is that militias engage in more licit markets than drug gangs. Around 10% of drug gangs control the provision and distribution of these services — with the exception of land and real estate, in which 21% of gangs explore these markets. On the other side, it is more common for militias to control shares of provision of services and goods. Despite the fall between 2009 and 2019, militias are still very strong in the market of cable TV and internet for territories controlled by them. Furthermore, while their investments in the distribution of cooking gas and transportation seem to have declined, they have increased their participation in water distribution, electricity, and construction — markets with high entry costs.

In summary, there has been a change in the composition of activities exploited by these groups. Militias now invest in the selling of illegal substances and increased their participation in legal activities such as the provision of

²²Gas and water refer to cooking gas cylinders and water gallons.

²³This confirms previous studies that describe the activities of these groups in selected territories.

electricity and the distribution of water. Drug factions maintain drug trafficking as their main business, but also engage in extortion. Most importantly, drug factions have not changed their portfolios as much as militias. In the next section we explore the reasons behind this difference.

Table 5: Share of Militias and Drug Gangs exploiting economic activities

	Criminal Group					
	Militias			Drug Gangs		
	2009	2019	$\Delta(p.p.)$	2009	2019	$\Delta(p.p.)$
<i>Panel A: Illicit Goods and Services</i>						
Drugs	19%	22%	3	100%	98%	2
Extortion	92%	91%	-1	28%	30%	2
Loan Sharking	10%	28%	18	2%	6%	4
Gambling	28%	11%	-17	7%	7%	0
<i>Panel B: Licit Goods and Services</i>						
TV & Internet	66%	41%	-25	11%	15%	4
Transportation	31%	14%	-14	14%	2%	-12
Properties and Land	19%	24%	5	19%	21%	2
Electricity	7%	19%	12	5%	6%	1
Water	15%	27%	12	5%	7%	2
Gas	38%	38%	0	7%	10%	3

Notes: This table illustrates the variation of criminal activities exploited by militias and drug gangs. Panel A shows activities that are illegal while panel B shows activities that are legal, i.e. they are usually provided by non-criminal firms. Δ (p.p.) is the variation between the years of 2009 and 2019.

5 Theoretical Framework

To theorize when criminal groups become criminal enterprises, we develop a model to analyze the strategic decision of criminal groups to fight against the state and other rival groups. Criminal enterprises are criminal actors that can exert coercion in a given territory in order to establish local monopolies of illegal and legal goods and services. In order to accomplish this goal, these groups need to fight two enemies: the state, which holds by law a monopoly over coercion and other criminal groups that also seek to exploit these markets. Therefore, a key decision for criminal groups is whether to invest in military capacity to protect their turf from the state and rival groups. This investment is costly and prevents the group from investing in their business enterprise. However, military capacity is crucial to guarantee

property rights. In this section, we present a model in order to analyze how criminal groups' decisions depend on state and rival groups' response. This allows us to understand the conditions needed to achieve two different equilibria: one with high levels of violence and low economic diversification and the other with low levels of violence and high economic diversification. This model also helps us to understand how the characteristics of drug gangs and militia groups may make the equilibrium with lower violence easier to achieve.

5.1 Intuition of the Model

The theory is based on a game theoretic model that sheds light on the strategic interactions between criminal groups and the state. A criminal group controls a territory when it successfully uses force or threats to suppress competition and maximize profits in this territory. In practice, to achieve this, the group may employ different levels of military control over an area to deter contestants.²⁴

The first contestant is law enforcement agents that represent the state repression apparatus, especially the police. When law enforcement agents use military means to enforce the law and criminal groups engage in direct confrontation the results are intense conflict and violence. When the state is willing to negotiate with criminal groups and these groups decide to engage in corruption and bribery, an equilibrium with low violence emerges alongside opportunities to exploit more markets. Therefore the decision on whether and how aggressively to seize illegal goods or jail or kill crime bosses affects criminal groups' time horizons (Castillo & Kronick, 2020), and thus their ability to invest in more markets. In this case, group connections with police officers to avoid repression may affect violence and economic outcomes.

On top of the state, the control over a particular area can be constantly challenged by other criminal groups who also want to exploit markets in the territory to extract rents. Hence, if criminal groups have to dispute the territory with other groups, they have to spend more in conflict, and they can

²⁴Blattman et al. (2018) document the role of *razones* in supplying protection and regulating conflict among Combos in Medellin. In El Salvador, violence levels dramatically dropped after the truce between the gangs broke (Cruz & Durán-Martínez, 2016). In Italy, *cosca mafiosa* manages relationships among the criminal groups and regulates disputes (Anderson, 1995). There is very limited research on whether these territorial criminal enterprises engage in negotiations to set boundaries and resolve disputes but historically criminal groups in Rio de Janeiro are intermittently involved in gunfights (Monteiro & Rocha, 2017) which suggest that there is no mechanism in place to resolve disputes with less violence. Nevertheless, the literature has emphasized that gang truces and other types of negotiations have proven unstable (Cruz and Duran-Martinez, 2016).

lose their territory and profits from economic activities within the territory at any moment. Conversely, if a group dominates an area such as there are no threats from other groups to challenge their power, they consolidate their local authority affecting aspects of everyday life — such as who enters and exits a community — and are able to diversify their economic activities. Therefore, territorial criminal enterprises must engage in dispute or collusion with the legal government in order to be able to coerce the population and establish its domain. This theory not only helps understand the behavior of these groups, but also allows us to explain violence and when groups expand their economic activities.

5.2 A Model of Territorial Criminal Enterprises

5.2.1 Setup

Our framework is based on a normal-form game with two types of agents: criminal groups and the state. An Incumbent criminal group i controls a territory that can be contested by a Rival group j or the State s . We present this model for two scenarios.

First, criminal market is consolidated and there is only one criminal group i that is only contested by the state. This is the case for territories that are either isolated or when there are large areas controlled by a single group. In the second scenario, besides the state, there is a rival criminal group threatening the incumbent turf. Rival group j faces the exact same incentives as incumbent group i in his territory and is contested both by the other criminal group and the state.

5.2.2 Case 1: One Criminal Group and State Intervention

In this case, there are two players: the incumbent criminal group i and the state s . Criminal group i chooses whether to invest or not in arming to fight and protect its territory, which we model as strategies $\{Fight, Not\ Fight\}$. Simultaneously, the state s decides whether to intervene militarily in a territory and repress the group or not, i.e. it chooses from the strategy set $\{Intervene, Not\ Intervene\}$. Table 6 presents the payoffs each agent gets for each combination of strategies.

Table 6: Payoff matrix - one criminal group and the state

		State	
		<i>Intervene</i>	<i>Not Intervene</i>
Incumbent	<i>Fight</i>	$\pi_i - c_f, \rho - c_g$	$\pi_i - c_f, 0$
	<i>Not Fight</i>	$\pi_i - g, \rho - c_g$	$\pi_i + \pi_i^k - b, b$

The incumbent i always manages to extract profit π_i from local economic activities. Fighting is costly for the criminal group and it incurs a cost c_f when it chooses to arm itself. However, fighting avoids economic losses g from state intervention, which otherwise negatively impacts the criminal group's payoff. This economic loss is associated with seizures, disturbances in economic activities and arrests or deaths of members of the criminal group. When the incumbent decides not to fight and the state does not intervene, a bribe b is transferred to the police. In this case, colluding with state avoid the cost of conflict which allows the criminal group to expand its business and exploit an additional market k : π_i^k .

For the state, besides the bribe b it may receive from the incumbent group, the parameters that govern its decision are related to the costs and benefits of the intervention. In order to contest the criminal group, it incurs c_g , which are associated with the costs of military capacity. On the other hand, there is a political return ρ of being tough on crime and fighting criminal groups²⁵.

For simplicity, we assume that $\pi_i^k > b$, which implies that rents from other economic activities are high enough to bribe state agents. We assume $\rho > c_g$, otherwise the state would not have an incentive to repress criminal groups. This assumption maps with the empirical observation that military police intervention often occurs.

Best Responses and Nash Equilibria

Incumbent's strategy $S_{incumbent}$ is as follows:

$$S_{incumbent} = \begin{cases} Fight & \text{if } S_{state} = Intervene \text{ and } g > c_f \\ Not Fight & \text{if } S_{state} = Not Intervene \end{cases}$$

²⁵Claudio Castro, the state governor of Rio de Janeiro, said when running for reelection that "if I were to follow electoral surveys, I would do military interventions as the one in Vila Cruzeiro once a week", referring to a police raid that killed 23 people in a *favela* controlled by CV in Rio. This highlights how the state may benefit politically from being tough on criminal groups (<https://g1.globo.com/politica/blog/octavio-guedes/post/2022/06/08/se-eu-me-baseasse-por-pesquisa-faria-uma-operacao-policial-por-semana-afirma-claudio-castro.ghtml>)

If the state intervenes, the criminal group invests in military capacity and fighting if $g > c_f$. If the state does not intervene, the criminal group does not fight because $\pi_i^k - b > -c_f$.

For the State, the best strategy is:

$$S_{state} = \begin{cases} \text{Intervene} & \text{if } S_{incumbent} = \text{Fight} \\ \text{Not Intervene} & \text{if } S_{incumbent} = \text{Not Fight and } b > b^* \end{cases}$$

If the criminal group invests in military capacity, the state intervenes because $\rho > c_g$. If the criminal group does not invest in military capacity, there is a level of bribe $b^* = \rho - c_g$ that makes the state indifferent in using repression. Therefore, for bribes $b \in (b^*, \pi^k)$ this game has two Pure Strategy Nash equilibria: {Fight, Intervene} and {Not Fight, Not Intervene}.

This simple framework leads to interesting insights. First, there is an incentive for groups not to engage in fights whenever there are rents they can collect in a peaceful environment. Second, the bribe needed to avoid state repression increases with the political return to the use of military force. This relationship between bribes and state repression has been pointed out by other scholars. Misse (1997) argues that increased police repression of markets of illicit goods raises the shadow market for 'political goods' (mercadorias politicas), roughly speaking, bribes. Lessing, 2017 argues that Rio de Janeiro's police can credibly threat to use force any time a bribe agreement is not reached due to low police accountability and the strong warrior ethos.

This setup also helps us think about the difference between drug gangs and militia groups. While both can collude with the government, militia groups are better able to avoid economic losses from government crackdowns. This occurs because they have policemen in their ranks who provide key pieces of information used to avoid seizures and arrests even when the state decides to intervene. In our context, this could be modeled as lower levels g for militias in comparison with drug gangs: $g_m < g_d$.²⁶ Therefore, for militia groups that are able to influence g_m to the point that it is lower than c_f , investment in military capacity is a dominated strategy because there

²⁶Given their proximity with state agents, militias are more likely to be informed about state interventions in controlled territories. Therefore, they can prepare beforehand, avoiding apprehension and seizure of products. According to statements by a state prosecutor, when there is a military operation in an area controlled by drug factions, the police seize drugs and guns. This is a huge cost for drug factions. However, when operations happen in territories controlled by militias, the operation is less likely to generate economic losses. Militias can hide and avoid the economic loss caused by interventions.

is not a threat of big economic losses due to state repression, and the only equilibrium is {Not Fight, Not Intervene}.

5.2.3 Case 2: Two Criminal Groups and State Intervention

We advance our framework to incorporate another criminal group, a rival group j . Intuitively, when another group controls a nearby territory, an incumbent faces the threat of losing its territory to the contender. Rival group j is symmetric to the incumbent, which means it chooses whether to fight or not to protect its territory from the state and the nearby group. Table 7 presents the payoff matrix for this scenario.

The main difference from Table 6 is that the decision of the rival group j affects the payoff of the incumbent i . If one criminal group fights and the other concedes, the criminal group takes its rival's territory and rents. $I(j = F)$ is an indicator function that turns one when the rival group invests in military capacity to contest the incumbent group. π_i represents the income from territory controlled by i and π_j represents the income from territory controlled by j .

Table 7: Payoffs for the game with two criminal groups and the state

		State	
		<i>Intervene</i>	<i>NotIntervene</i>
Incumbent	<i>Fight</i>	$(\pi_i + \pi_j * (1 - I(j = F)) - c_f, \rho - c_g)$	$(\pi_i + \pi_j * (1 - I(j = F)) - c_f, 0)$
	<i>NotFight</i>	$(\pi_i - \pi_i * I(j = F) - g, \rho - c_g)$	$(\pi_i + \pi_i^k - (\pi_i + \pi_i^k) * I(j = F) - b, b)$

Best Responses and Nash Equilibria

First, the decision of the state is equivalent to the previous scenario with only one group: the state intervenes whenever the incumbent group invest in military capacity, and does not intervene otherwise as long as $b > \rho - c_g$. The criminal group's decision follows the strategy profile below:

$$S_{incumbent} = \begin{cases} Fight & \text{if } S_{state} = Intervene \text{ and } S_{rival} = Fight \\ Fight & \text{if } S_{state} = Intervene \text{ and } S_{rival} = Not Fight \\ Fight & \text{if } S_{state} = Not Intervene \text{ and } S_{rival} = Fight \\ Fight & \text{if } S_{state} = Not Intervene, S_{rival} = Not Fight \text{ and } \\ & \pi_j - c_f > \pi_i^k - b \end{cases}$$

If the rival group fights (the first and third scenarios), the incumbent's decision to fight is straightforward since its territory and rents π_i are threatened otherwise. In this case the incumbent always chooses to fight because

its payoff would be lower otherwise, regardless of the state's decision to intervene ($\pi_i - c_f > -g$) or not ($\pi_i - c_f > -b$). Likewise, the possibility to take the rents from the rival's territory exceeds the opportunity cost of not fighting whenever the rival decides not to fight and the state intervenes ($\pi_j - c_f > 0 > -g$).²⁷

When the state does not intervene and the rival does not fight ($j = N$), the incumbent decision depends on the economic returns of acquiring the rival's territory ($\pi_j - c_f$) and net profits from exploiting additional markets locally ($\pi_i^k - b$). If $\pi_j - c_f > \pi_i^k - b$, then the only Nash equilibrium is the one in which groups fight and the state intervenes. However, the model indicates that it is possible to have a second Nash equilibrium equilibrium where nobody fights if the bribe is high enough ($b > \rho - c_g$) and the net profits from additional markets is higher than the rents from conquering another territory ($\pi_i^k - b > \pi_j - c_f$).

Therefore, the conditions for a peaceful equilibrium when there are multiple groups and the state are much harder to achieve. In this case, g , the key parameter that differentiates militias from drug gangs, is not relevant for the equilibrium. The level of violence with multiple groups does not depend on the type of group, but rather on the ability to bribe state agents and to generate additional rents from other markets locally.

5.3 Predictions

This game with two scenarios allows us to understand why equilibria with different levels of violence and economic diversification may emerge. While the state's decision depends on the political benefits of repressing the groups, the criminal groups are affected by their disputes and attacks from enemies — the state and a rival criminal group — and the economic incentives of governing in a peaceful environment — which allows groups to exploit more economic activities. In other words, the interaction between criminal groups and the state determines the outcomes of interest: violence and economic outreach.

The economic opportunities that emerge in a more peaceful and consolidated environment are captured by π_i^k in our model. These activities include the provision of a diverse range of goods and services such as local transportation, the selling of gas canisters, the wholesale of bottled water, internet services and cable TV, and gambling, among others. These are markets

²⁷If the state intervenes and the rival group fights ($j = F$), the incumbent always fights ($\pi_i - c_f > 0 > -g$). If the state intervenes and the rival group does not fight ($j = N$), the incumbent always fights ($\pi_j - c_f > 0 > -g$). If the state does not intervene and the rival group fights ($j = F$), the incumbent always fights ($\pi_i - c_f > 0 > -b$).

that criminal groups generate profits by using its coercive power to suppress competition. However, this requires more investment and time horizon than selling illicit drugs or charging fees for protection. For instance, in order to enter the market for internet services, criminal groups must install cables and cut the infrastructure of other suppliers. Therefore, groups will diversify their activities when they are not being contested in a territory.

Our framework with state and criminal group interactions leads to three predictions for what we should observe in the data. The first prediction refers to the level of consolidation in the territory. When criminal groups are close to rival groups, they invest in more military capacity, increasing the level of conflict and state repression. This is summarized in the Prediction 1:

Prediction 1 *Areas with more than one criminal group are more violent because they experience more conflict and state repression.*

The equilibrium where groups and the state collude is more likely to emerge when criminal groups are isolated or consolidated in an area. When there is more than one group, on top of the state condition regarding the amount of the bribe ($b > \rho - c_f$), the equilibrium without conflict only emerges if the net profits from exploiting additional markets locally are high enough ($\pi_i^k - b > (\pi_j - c_f)$).

In addition, this game also sheds light on the comparative advantages of militia groups relative to drug gangs, which is stated in Prediction 2.

Prediction 2 *Areas where there is crime consolidation (isolated criminal group) are less violent if controlled by a militia group rather than a drug gang because they experience less state repression.*

Our model assumes that the economic loss g generated by the state is lower for militias ($g_m < g_d$). Therefore, militias have no incentive to fight when they do not face a threat of a rival group, and it is more likely to observe the equilibrium with low levels of conflict and state repression.

Prediction 3 refers to economic diversification of criminal groups when facing rival groups that generate distinct scenarios of criminal consolidation.

Prediction 3 *Criminal groups, especially the militia groups, exploit more markets when not facing the threat of a rival group.*

Criminal enterprises, which we argue control territories to extract rents, are more likely to exploit more markets when they are not being contested by other groups. In this case, the equilibrium in which criminal groups colludes with the state becomes more feasible, especially for militia groups that are more able to avoid state repression and concentrate its efforts to increase its economic outreach.

6 Empirical Strategy

This section details how we measure the effects of criminal group presence on violence and economic outreach. First, we test whether the number or type of criminal enterprises at neighborhood level is associated with several indicators of violence. As pointed out by Sobrino (2019) for Mexican Drug Cartels, the number of groups in the territory represents an important driver of local violence.

We run the following regression:

$$violence_{nt} = \alpha + \beta NumberCG_{nt} + \delta_n + \gamma_t + \epsilon_{nt} \quad (1)$$

where $violence_{nt}$ takes three different measures of violence for neighborhood n in year t : i) the total number of homicides; ii) the number of shootings using *Fogo Cruzado* NGO data, and iii) an indicator variable of police killings, a proxy for state repression. Both homicide and police killings are official records registered by the civil police and disclosed by ISP. The main explanatory variable is $NumberCG$ which refers to the total number of criminal groups in the neighborhood and comes from our novel panel dataset based *Disque-Denuncia*. We also include in the regression neighborhood and year fixed effects. The parameter of interest β captures how the number of criminal groups are associated with violence at the neighborhood level. In order to test whether the type of criminal group matters, we also run alternative regressions replacing $NumberCG_{nt}$ by indicator variables for whether there is the presence of militia groups, one drug faction and more than one drug faction at neighborhood n . This allows us to estimate changes in violence associated with changes in the type of group that rules an area. Therefore, any neighborhood characteristics that do not vary in the short run are controlled in our analysis.

The second outcome of interest is economic activities and diversification. We test whether the interaction between criminal enterprises is related to a higher degree of economic diversification within groups. To investigate this question, we combine information on economic activities reported to *Disque-Denúncia* and previous field work data from Alba Zaluar in 2009 and 2013, which identifies criminal group presence at the *favela* level. We refrain from using data from *Disque-Denuncia* to identify group presence in this exercise because our algorithm is a function of reports of criminal groups exploiting economic activities. Therefore, we use an independent source to determine which *favela* is controlled by which group in order to make our test cleaner. In this case, we define that a group exploits a given market if there is at least one report for this practice in its territory. Our dependent variables are

three-fold: i) whether a group extorts or charges of fees for protection; ii) whether a group engages in illegal drug retail trade and iii) the sum of other exploited markets (gas canister, water, internet, transportation, electricity, gambling, real state and loan sharking). Equation 2 specifies the model.

$$EconActivity_{fy} = \alpha + \beta I(Rival = 0)_{fy} + \delta_f + \gamma_y + \epsilon_{fy} \quad (2)$$

For a given *favela* f , we test whether changes in having at least one rival nearby affects the economic activities (*EconActivity*) exploited by the incumbent. We define that a group in a *favela* faces a rival in its surroundings if another group rules another *favela* that is within 1000 meters.²⁸ We use the lack of a rival group nearby as a measure of criminal consolidation. Equation 2 adds *favela* fixed effects and year fixed effects to uncover the effect of having a rival nearby controlling for a specific time and *favela* invariant characteristics.

7 Results

Our model suggests that areas with more than one group experience more conflict and state repression (Prediction 1) and that criminal groups exploit more markets when not facing the threat of rival groups (Prediction 3). In addition, it indicates that militia groups are more likely to end in the peaceful equilibrium because they are able to avoid the losses produced by state repression and even reduce state intervention. This implies that areas where militia groups consolidate their territorial control are less violent because they experience less state repression than areas with only one drug gang (Prediction 2).

To test these predictions, we estimate a two-way fixed effect model from equation 1 for three measures of violence: two proxies of conflict between groups (homicides and shootings) and one proxy for state repression (police killings). We test Prediction 1 by regressing these variables on the number and type of criminal enterprises. We explore within neighborhood variation which implies that we test how the *change* in the number of criminal groups is correlated with the degree of conflict and state repression. Columns (1), (3) and (5) of Table 8 indicate that an additional criminal group in a neighborhood is associated with 0.69 more homicides (or 34%), 2.08 more shootings (or 82%) and an increase in 0.04 in the likelihood of having someone killed by police (or 33%).

²⁸The results are robust to alternative distances: 500m, 1500m and 2000m.

Columns (2), (4), and (6) replicate the same regressions changing the explanatory variables to categorical variables indicating four possible types of ruling in the neighborhood, as shown in Figure 5. The coefficients associated with *Criminal Groups >1*, *Only Militia* and *Only one Drug Gang* refer to the increase in violence relative to periods without any groups in the neighborhood (reference category). Column 2 shows that homicides are 27% more common in territories with only one drug gang and 71% higher when there is more than one criminal group. Interestingly, the results indicate that neighborhoods controlled by militia groups do not register more homicides than neighborhoods without criminal groups.²⁹ As expected, column 4 shows that shootings are a lot more likely when more than one criminal group is present at the neighborhood, 124% on average. Results shown in column 6 confirm prediction 2 and indicate that state military intervention is less frequent in neighborhoods where only militia groups are present. Similar to homicide results, these areas do not register more police killings than neighborhoods without criminal groups. On the other hand, neighborhoods with just one drug gang are 5.6 p.p. more likely to register this type of event at least once (a 47 % increase). Moreover, the number of police killings are higher when there are more than one criminal group at the neighborhood: an additional criminal group is associated with 10 percentage points increase in the likelihood of having a police killing, which represents a 83% increase. In sum, these results corroborate the previous evidence that having more than one group is associated with overall levels of violence and support our model's prediction that the police uses more force against drug gangs.³⁰

²⁹Some people in Rio de Janeiro argue that the lower levels of homicides in militia territories are explained by higher levels of forced disappearances. We ran the same regressions using forced disappearance as dependent variable and did not find any association with type of group.

³⁰Appendix E presents results using Poisson regression models with roughly the same conclusions.

Table 8: Group presence and violence

	<i>Dependent variable:</i>					
	Homicides		Shootings		Police Killings	
	(1)	(2)	(3)	(4)	(5)	(6)
Number of groups	0.691*** (0.160)		2.076*** (0.613)		0.042*** (0.009)	
N Groups >1		1.462*** (0.298)		3.097** (1.318)		0.103*** (0.022)
Only Militias		-0.530 (0.339)		0.314 (0.759)		-0.042 (0.026)
Only one Drug Gang		0.554*** (0.142)		-0.039 (0.801)		0.056*** (0.015)
Mean DV	2.04	2.04	2.50	2.50	0.12	0.12
Neighborhood FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
R ²	0.818	0.818	0.886	0.886	0.493	0.495
Observations	9,504	9,504	2,376	2,376	9,504	9,504
Neighborhoods	792	792	792	792	792	792
Years	12	12	3	3	12	12

Notes: This table illustrates the main effects of territorial criminal enterprises on violence. The table reports coefficients obtained from the estimation of OLS models of equation (1). *Number of TCE* is the total number of groups in the neighborhood. *TCE > 1* is an indicator variable taking value 1 if there is more than one group. *Only Militias* is an indicator variable taking value 1 for neighborhoods with only militia presence. *Only one Drug Gang* is an indicator variable taking value 1 for neighborhoods with the presence of only one drug gang presence. For Homicides and Shootings, the dependent variable is the sum of events in a given year-neighborhood whereas for Police Killings it is an indicator variable that indicates whether there is at least one event for a neighborhood in a year (Linear Probability Model). Mean DV refers to the mean value for each dependent variable in neighborhoods without any group. Std. Error clustered at the neighborhood level. *p<0.1; **p<0.05; ***p<0.01.

Economic Activities and Diversification

To test Prediction 3, that criminal groups, especially the militias, exploit additional markets when not facing the threat of a rival group, we look at

three different economic outcomes: (1) extortion, (2) drug trafficking, and (3) other markets. These variables are measured using the Disque Denuncia data and indicate the main economic activities of militia groups and drug gangs respectively as well as the sum of any other economic activity. To avoid using the same data source for both our dependent and independent variables, we use data on group presence at the *favela* level provided by Zaluar. In this analysis, we reduce our sample for the period of 2009 and 2013 due to data availability.

The main explanatory variable is our measure of criminal consolidation: a dummy variable indicating that there is no rival group in *favelas* located within 1000m from the incumbent group. Table 9 presents the results in two different panels, one for *favelas* whose incumbent is a militia group (Panel A) and another one for *favelas* run by one of the three drug gangs (Panel B). The results indicate that when militias are consolidated in a territory, the probability of engaging in extortion increases in 25 percentage points or 43%. Also, as predicted by our model, militia groups exploit on average one additional market when there is no rival group threatening its territory, which represents a four-fold increase in the average number of additional markets exploited (0.24).

Interestingly, this does not seem to be the case for drug gangs, as shown in Panel B. We do not find that drug factions expand their activities, including drug trafficking, when they are alone in a territory. From our model and the results from Table 8, we argue that this key difference is explained by their relationship with the state: relative to militias, drug gangs are more likely to be contested by the state when not facing threat from rival groups. In sum, the heterogeneity of our results most likely reflects the different degrees of interaction that these groups have with the state.

Table 9: Criminal consolidation and economic activities

	<i>Dependent variable:</i>		
	Extortion	Drugs	Other markets
	(1)	(2)	(3)
<i>Panel A: Militias</i>			
I(Rival = 0)	0.254** (0.117)	0.154 (0.147)	1.011** (0.498)
Constant	0.589*** (0.026)	0.000 (0.019)	0.236*** (0.067)
Observations	534	534	534
R ²	0.658	0.570	0.716
<i>Panel B: Drug Factions</i>			
I(Rival = 0)	0.039 (0.079)	0.006 (0.101)	−0.045 (0.173)
Constant	−0.007 (0.042)	0.925*** (0.053)	0.087 (0.095)
Observations	718	718	718
R ²	0.582	0.622	0.716

Notes: This table illustrates the main effects of territorial criminal enterprises interactions on economic activities. The table reports coefficients obtained from the estimation of the equation (2). Panel A reports the coefficients using the sample of only favelas with militia presence. Panel B reports coefficients using the sample of favelas with drug gangs. $I(Rival = 0)$ is an indicator variable taking value 1 when the groups do not have other groups occupying neighboring territories. Std. Error clustered at the neighborhood level. *p<0.1; **p<0.05; ***p<0.01.

8 Conclusion

Criminal groups are one of the main public security threats in many countries around the world. They govern territories, increase violence, and affect the life of millions of people. This paper analyzes these groups through the lens of criminal enterprises — i.e. profit-maximizing firms that dispute with the state the monopoly of coercion in a given territory to exploit economic markets. We create a novel dataset to map the presence of this type criminal enterprises in neighborhoods of Rio de Janeiro and analyze the different markets exploited by them.

Our paper reveals that the levels of territorial domination of criminal groups in the city of Rio de Janeiro have not changed much over the last 12 years. Instead, we document a continuous increase in criminal group presence in the outskirts of the city of Rio de Janeiro. We also document that militia groups and drug factions are multi-product enterprises that exploit a wide range of licit and illicit goods and services. Past research has studied how state repression can affect cartel-state conflict (Lessing, 2018) or cooperation between traffickers (Castillo & Kronick, 2020). We contribute to this scholarship by studying how the strategic interactions between groups and the state can affect not only violence levels but also the markets exploited by these groups.

We build a model to explain how criminal groups interact with the state and other criminal groups and why equilibria with different levels of violence and economic diversification may emerge. We test the predictions of our model using within territory variation from a novel panel dataset combined with existing detailed data on criminal groups in Rio de Janeiro. Our main results show that territorial consolidation is correlated with economic diversification, but only for territories controlled by militias. Also, territories controlled by a single drug gang are more likely to experience state repression than territories controlled by militia groups. Finally, we show that a reduction in the number of criminal groups in a territory is associated with lower levels of violence.

The difference between militias and drug gangs is of remarkable importance to our understanding of criminal groups. We argue that the heterogeneity of our results is due to militia’s better capacity to avoid state repression. This also applies to other criminal groups that are able to negotiate with the state and corrupt police officers, as in the case of Mexico and Italy. This indicates that even in scenarios with low levels of violence, these groups may be flourishing and becoming even bigger threats to state power.

Our data also suggest that most of the policies that governments have pursued so far have been insufficient in curbing the expansion of these groups.

Since the survival and growth of criminal groups depend on state policies and interactions with state agents, any policy to curb these groups needs to consider that many people who are supposed to implement these policies are oftentimes colluding with criminal groups. Therefore, the fight against criminal enterprises must encompass approaches to discipline and monitor the government repression apparatus and increase competition in the provision of public goods and services to reduce their revenues in poor areas.

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A *Disque Denuncia* reports

This section presents two examples of transcribed calls to *Disque-Denúncia*. The first refers to regular parties promoted by drug dealers to they sell drugs while heavily armed. The second report mentions militia members using firearms to charge monthly cash fees from residents. The words in bold exemplify how we used regular expressions to filter and classify reports.

“Informs that (...) **drug dealing** is intense during these parties and that these **drug dealers** are usually heavily armed (...)”

“Informs that (...) where local **militia members** (...), **carrying firearms, charge monthly cash fees** from local residents (...)”

B Measures of validity check

Precision evaluates the ability of correctly classifying reports as positives, conditional on being classified as positives — when there are no false positives, precision equals one. Recall evaluates the ability of correctly classifying reports as positive, conditional on the totality of true positive cases in the sample — when there are no false negatives, recall equals one. F1-score is the harmonic mean of the previous two measures — if F1-Score equals one, then the algorithm is always correct when it identifies a dimension in a report and never fails to classify reports of that dimension.

$$Precision = \frac{TruePositives}{TruePositives + FalsePositives} \quad (3)$$

$$Recall = \frac{TruePositives}{TruePositives + FalseNegatives} \quad (4)$$

$$F1 - score = 2 \times \frac{Precision \times Recall}{Precision + Recall} \quad (5)$$

C Neighborhoods with presence of territorial criminal enterprises

Figure 6: Presence of groups at cluster level in 2019

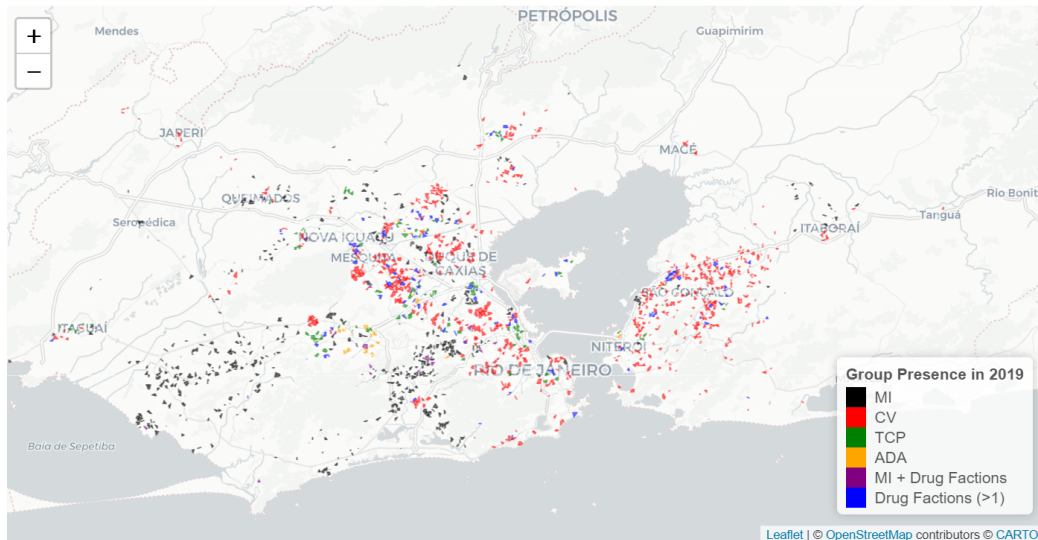


Figure 7: Percentage of neighborhoods with group presence - City of Rio de Janeiro

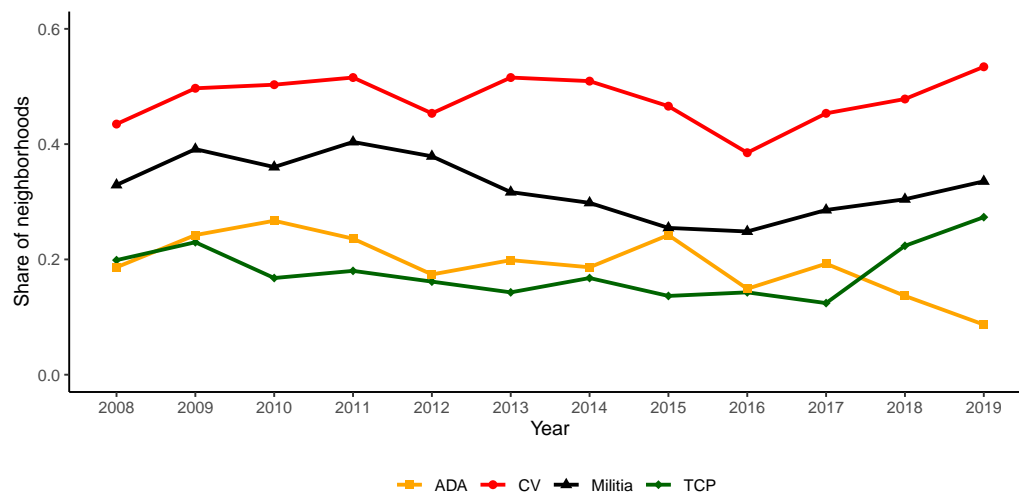
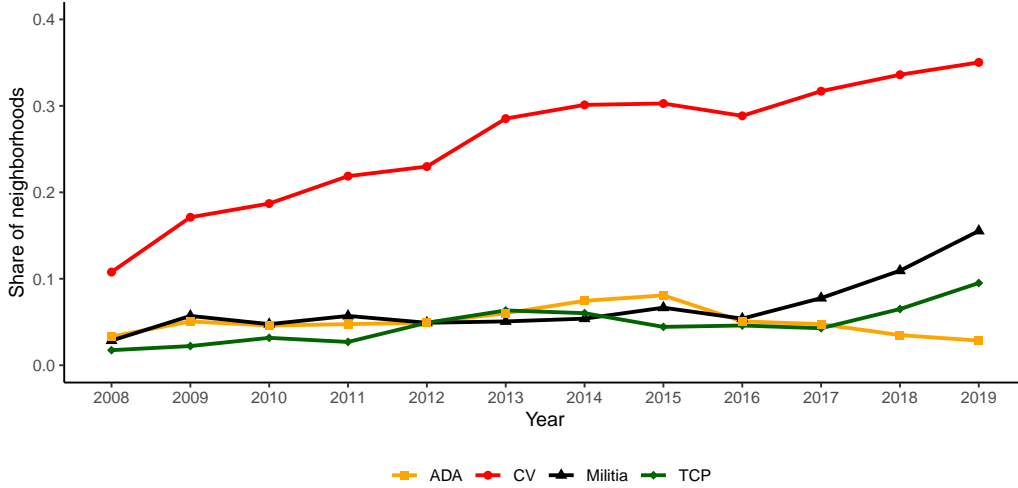


Figure 8: Percentage of neighborhoods with group presence - Metropolitan Area (excluding Rio de Janeiro city)



D Economic activities

D.1 Transportation

To describe the business of transportation, we use the case study of Ilha do Governador, a neighborhood in Rio with more than 200,000 people. This information is based on a lawsuit and the investigation conducted by Rafael Soares, journalist at O Globo.

The neighborhood was historically controlled by drug trafficker Fernandinho Guarabu. He was known for his long-lived sovereignty, which is rare given that most drug traffickers are killed or captured. Fernandinho Guarabu had a strategy of high level interaction with the state: instead of confrontation, he preferred to bribe police officers and negotiate arms and other equipment with them. In exchange, he was able to run the drug trade freely, his main business. He had 15 arrest warrants that were never implemented by the police. Another consequence of this, as expected by our theory, is that shootings and gunfights at Ilha do Governador rarely occur.

Fernandinho Guarabu started working with ex-police officer Antonio Eugenio de Souza Freitas, known as Batoré. Batoré was dismissed from the Military Police for diverting guns seized in operations to drug dealers on Ilha do Governador. In partnership with Fernandinho Guarabu, he starts controlling the business of vans in the neighborhood. They exploit the transportation market by charging fees to van drivers. According to the lawsuit,

they charged approximately US\$ 70 per week plus one dollar per day for each vehicle to circulate in the area. In total, 505 vans and kombis were subjected to the fees. From the legal document:

“A final aspect that demonstrates the special peculiarity of the case are the amounts collected by the criminal group, in fact, millions of reais per month, as evidenced in the case file, that there were 505 Vans and Kombis linked to Cooperative Shalon Fiel and that each one paid BRL 350.00 per week, in addition to BRL 5.00 reais per day, all of this combined with the exploitation of dozens of *bocas de fumo* (points of drug sales), reaching, without any major effort, the amount of millions of reais monthly collected, giving the criminal group, each month, more power to refinance itself, expand criminal activities, corrupt and dangerously infiltrate the state apparatus.” (page 642, Case file n. 0076551-23.2013.8,19.0001, Rio de Janeiro State Court)

Violence was used to enforce the payment. In addition to violence, they used other strategies, as described by the lawsuit:

“... vehicles of recalcitrant drivers, when not set on fire, were taken to the interior of the *Dendê favela* (main stronghold of “Fernandinho Guarabu”) and were only returned to the owners after payment of the full amount of the extortion. Added to this is the fact that extortionists make use of the entire military apparatus, routinely used in the exploitation of drug trafficking, as a means of coercion against Van and Kombis drivers who dared to rise up.” (page 21, Case file n. 0076551-23.2013.8,19.0001, Rio de Janeiro State Court)

D.2 Water distribution

Another business that is explored by criminal groups is water distribution. Documents by the Public Prosecutor’s Office of Rio de Janeiro which is responsible to file criminal charges, describe the activities of militia groups in the west zone of Rio de Janeiro. The militia group established a duopoly for the sale of water gallons in two districts of Rio de Janeiro.

The head of the militia group of Jacarepagua, Orlando Curicica, partnered with a merchant who purchased higher quality water for a lower price. They agreed to segment the market between them and each would operate in a specific area with a margin of 100% on the highest quality product and 158% on the lowest quality product.

E Results - Poisson

This section presents the results from Poisson models analogous to equation 1. The conclusions are virtually the same as in our main specification.

Columns (1), (3) and (5) show that an additional criminal group in a neighborhood is associated with 9.9% more homicides, 13.1% more shootings and 17.7% more police killings. Columns (2), (4), and (6) show that the coefficients associated with $TCE > 1$, *Only Militias* and *Only one Drug Gang* refer to the increase in violence relative to periods without any groups in the neighborhood (reference category). Homicides are 15% more common in territories with only one drug gang and 27.4% higher when there is more than one TCE. Neighborhoods controlled by militia groups do not register more homicides than neighborhoods without criminal groups. As expected, shootings are 32% more likely when more than one criminal group is present at the neighborhood. On the other hand, neighborhoods where more than one criminal group is present experience 66% more police killings than areas with no criminal groups, while neighborhoods with just one drug gang are 33% more likely to register this type of event.

Table 10: Group presence and violence

	<i>Dependent variable:</i>					
	Homicides		Shootings		Police Killings	
	(1)	(2)	(3)	(4)	(5)	(6)
Number of TCE	0.094*** (0.014)		0.123*** (0.035)		0.163*** (0.031)	
TCE >1		0.242*** (0.035)		0.280*** (0.093)		0.508*** (0.086)
Only Militias		-0.007 (0.044)		0.107 (0.135)		-0.015 (0.147)
Only one Drug Gang		0.140*** (0.032)		0.087 (0.095)		0.287*** (0.071)
Model	Poisson	Poisson	Poisson	Poisson	Poisson	Poisson
Mean DV	2.04	2.04	2.50	2.50	0.23	0.23
Neighborhood FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	9,504	9,504	2,376	2,376	9,504	9,504
Neighborhoods	792	792	792	792	792	792
Years	12	12	3	3	12	12

Notes: This table illustrates the main effects of territorial criminal enterprises on violence. The table reports coefficients obtained from the estimation of the equation (1). *Number of TCE* is the total number of groups in the neighborhood. *TCE > 1* is an indicator variable taking value 1 if there is more than one group. *Only Militias* is an indicator variable taking value 1 for neighborhoods with only militia presence. *Only one Drug Gang* is an indicator variable taking value 1 for neighborhoods with the presence of only one drug gang presence. Std. Error clustered at the neighborhood level. *p<0.1; **p<0.05; ***p<0.01.